

(12) **United States Patent**
Hartmann et al.

(10) **Patent No.:** **US 9,898,311 B1**
(45) **Date of Patent:** **Feb. 20, 2018**

(54) **SOFTWARE INSTALLATION THROUGH
BOOTLOADER MANAGEMENT**

(71) Applicant: **AMPLIFY EDUCATION HOLDING,
INC.**, New York, NY (US)

(72) Inventors: **Joshua Hartmann**, Brooklyn, NY
(US); **Christopher Scott Rooney**,
Brooklyn, NY (US); **Nilesh Shah**,
Monmouth Junction, NJ (US); **Praful J.
Todkar**, San Francisco, CA (US);
Steven David Turner, Richmond Hill
(CA)

(73) Assignee: **AMPLIFY EDUCATION HOLDING,
INC.**, New York, NY (US)

(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 515 days.

(21) Appl. No.: **14/586,275**

(22) Filed: **Dec. 30, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/921,801, filed on Dec.
30, 2013.

(51) **Int. Cl.**
G06F 1/00 (2006.01)
G06F 1/24 (2006.01)
G06F 9/445 (2018.01)
G09B 5/00 (2006.01)
G06F 21/57 (2013.01)

(52) **U.S. Cl.**
CPC **G06F 9/44505** (2013.01); **G06F 8/61**
(2013.01); **G06F 21/572** (2013.01); **G09B**
5/00 (2013.01); **G06F 2221/033** (2013.01)

(58) **Field of Classification Search**

CPC G06F 9/44505; G06F 8/61; G06F 21/572;
G06F 2221/033; G06F 9/44; G06F 8/65;
G09B 5/00
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

9,552,479 B2 * 1/2017 Yu G06F 21/56
2011/0099547 A1 * 4/2011 Banga G06F 8/61
717/176

* cited by examiner

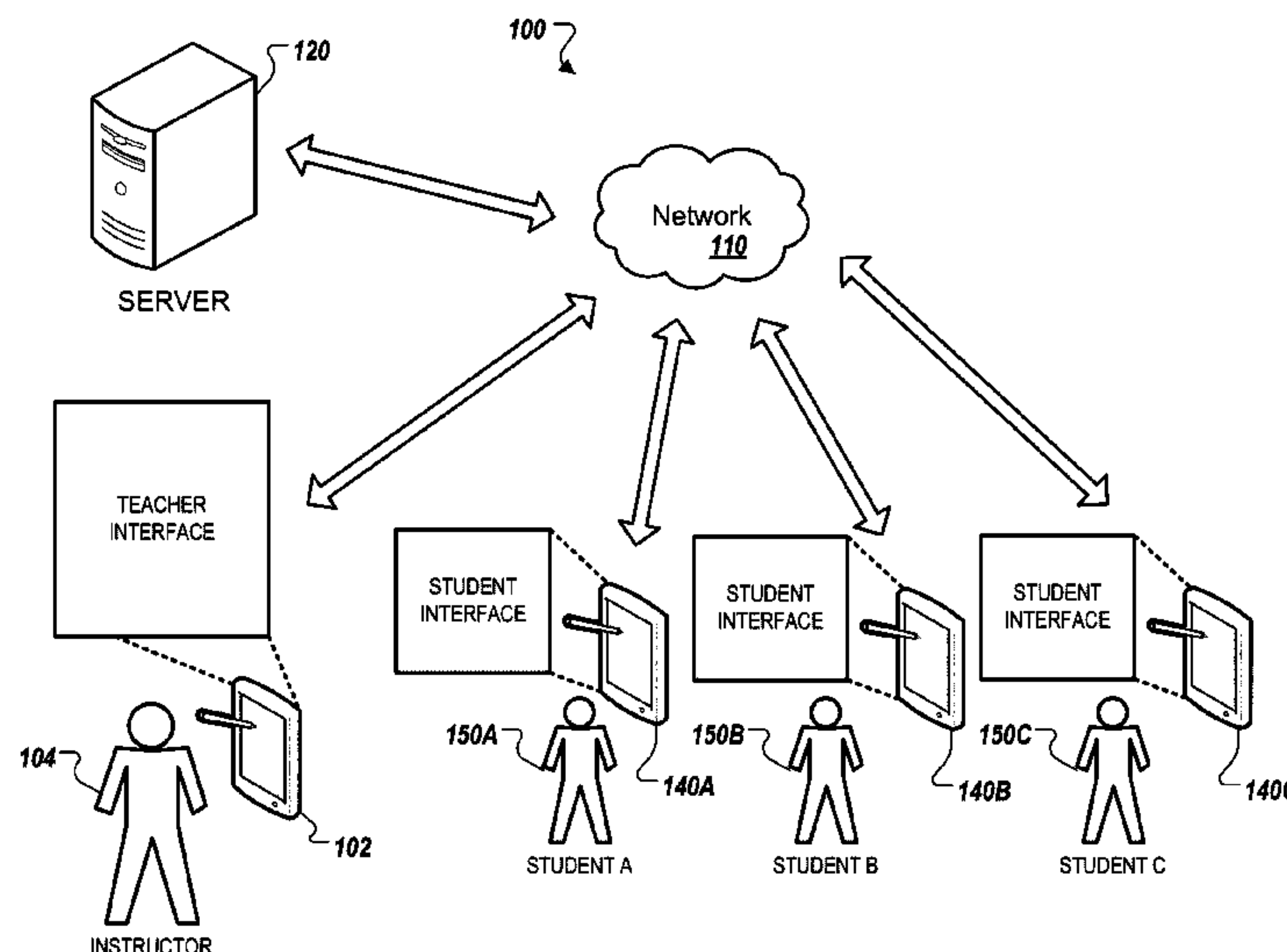
Primary Examiner — Phil Nguyen

(74) *Attorney, Agent, or Firm* — Leason Ellis LLP

(57) **ABSTRACT**

A bootloader detects that an operating system of a computing device has finished booting. In response to detecting with the bootloader that the operating system of the computing device has finished booting, installation of software on the computing device except for particular educational software is disabled. The particular educational software is determined not to be installed on the computing device. In response to determining that educational software is not installed on the computing device, the particular educational software is installed. After installing the particular educational software, a boot sequence of the computing device is modified so that the particular educational software is executed after the operating system has finished booting. The bootloader is disabled.

12 Claims, 3 Drawing Sheets



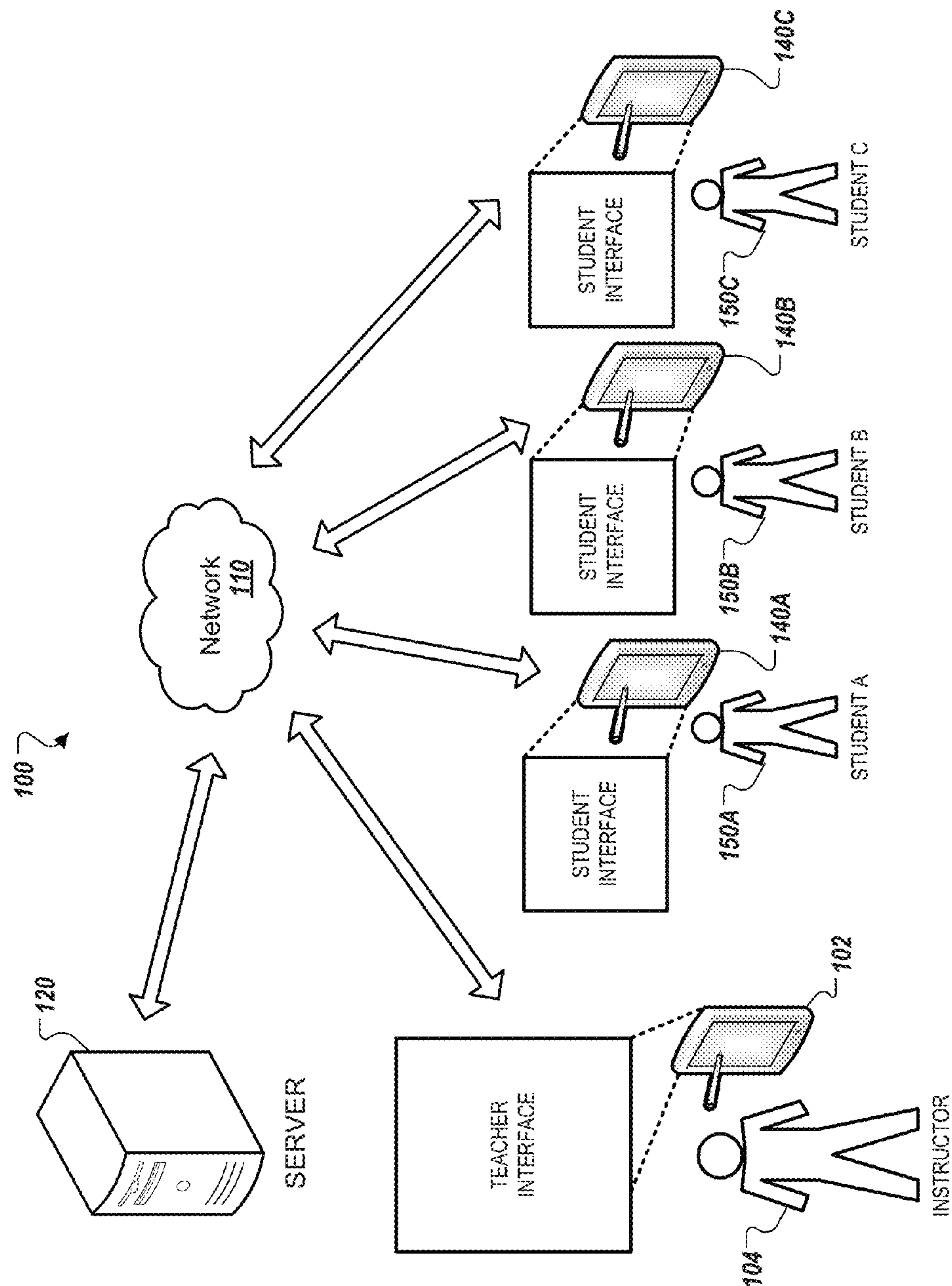


FIG. 1

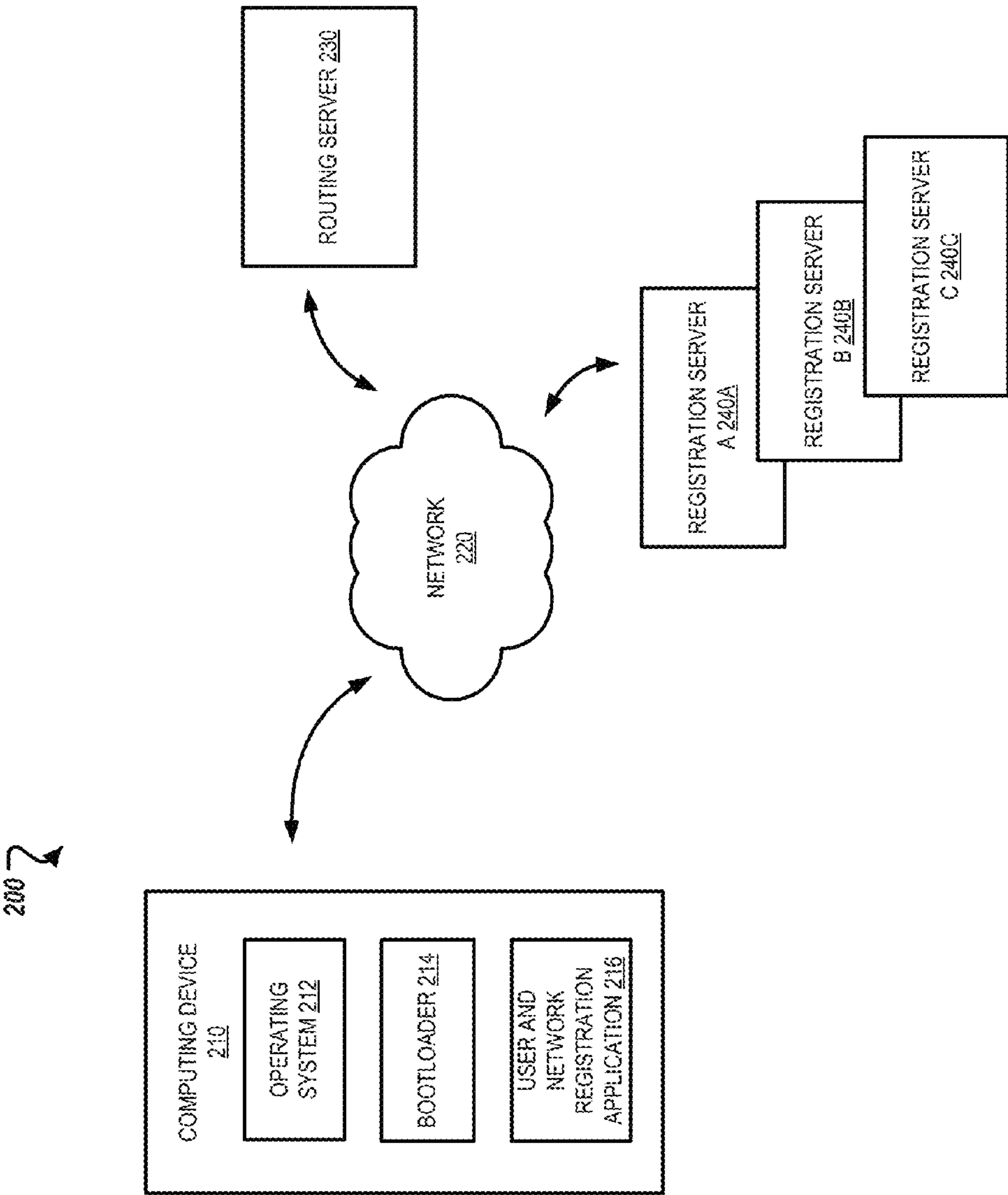


FIG. 2

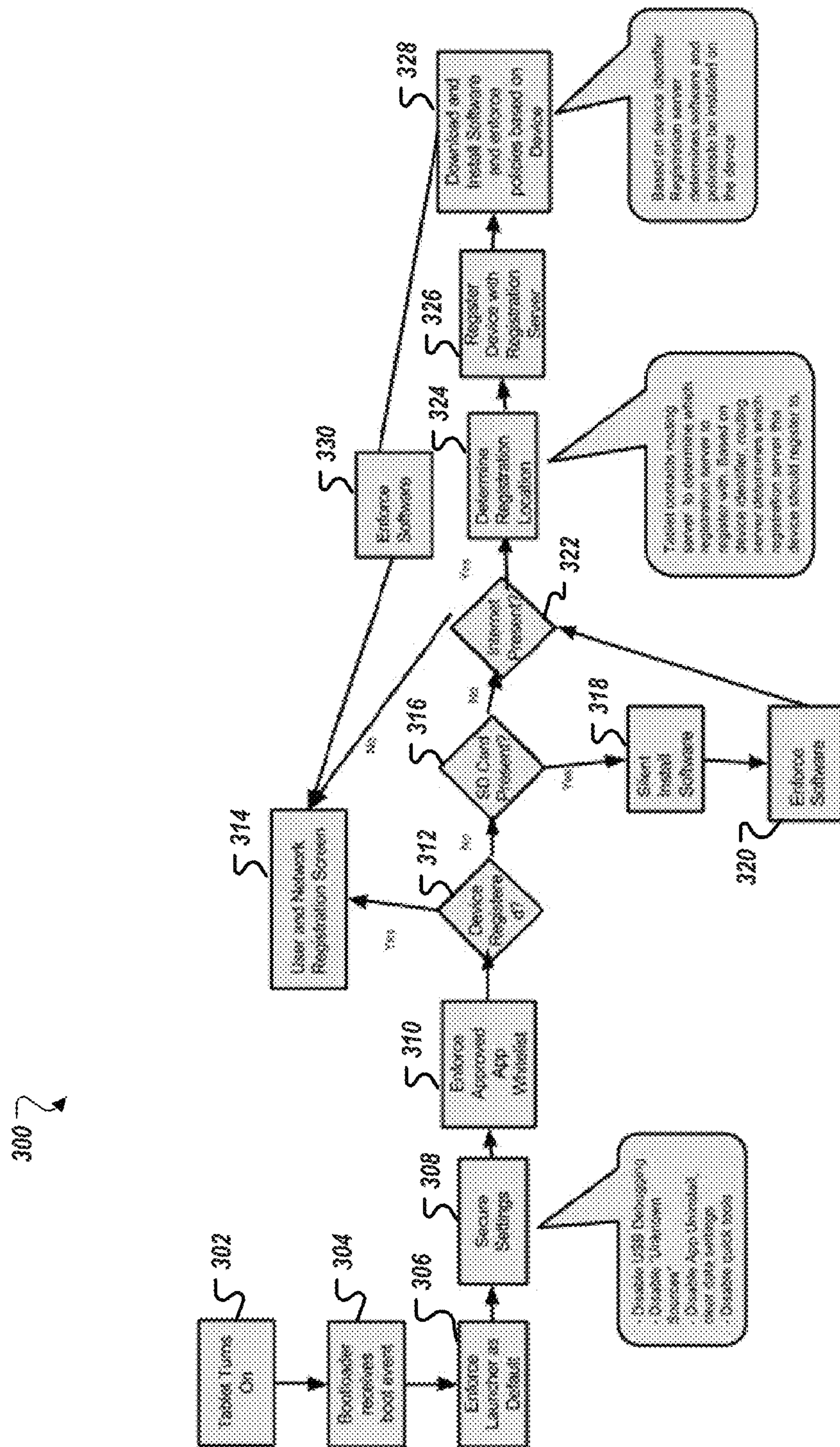


FIG. 3

1

**SOFTWARE INSTALLATION THROUGH
BOOTLOADER MANAGEMENT****CROSS-REFERENCE TO RELATED
APPLICATION**

This application claims the benefit of U.S. Provisional Application Ser. No. 61/921,801, filed on Dec. 30, 2013, which is incorporated by reference

TECHNICAL FIELD

This specification relates to managing a computing device.

BACKGROUND

In certain circumstances, computing devices may need to be managed.

SUMMARY

In some aspects, the subject matter described in this specification may be embodied in methods that may include the actions of detecting with a bootloader that an operating system of a computing device has finished booting. Additional actions include, in response to detecting with the bootloader that the operating system of the computing device has finished booting, disabling installation of software on the computing device except for particular educational software and determining that the particular educational software is not installed on the computing device. Further actions include in response to determining that educational software is not installed on the computing device; installing the particular educational software. Additional actions include after installing the particular educational software, modifying a boot sequence of the computing device so that the particular educational software is executed after the operating system has finished booting and disabling the bootloader.

Other implementations include corresponding systems, apparatus, and computer programs, configured to perform the actions of the methods, encoded on computer storage devices.

These and other implementations may each optionally include one or more of the following features. For instance, in some implementations, disabling installation of software on the computing device except for particular educational software includes obtaining a whitelist of educational software that is permitted to be installed and enabling the educational software on the whitelist to be installed. In certain aspects, the bootloader is installed in a protected system folder of the computing device. In some aspects, disabling installation of software on the computing device except for particular educational software includes disabling universal serial bus (USB) debugging for the computing device, the installation of software from unknown sources, clearing of settings, and quick tools that may be supported by the operating system. In some implementations, installing the particular educational software includes determining the presence of memory that is accessible by the computing device that stores installation data for the particular educational software and installing the particular educational software from the memory that is accessible. In certain aspects, disabling the bootloader includes modifying the boot sequence of the computing device so that the bootloader is not loaded.

2

The details of one or more implementation are set forth in the accompanying drawings and the description below. Other potential features, aspects, and advantages of the subject matter will become apparent from the description, the drawings, and the claims.

DESCRIPTION OF DRAWINGS

FIG. 1 is a block diagram of an example of a system architecture for using computing devices in a learning environment.

FIG. 2 is a diagram showing an example of a system for managing a computing device.

FIG. 3 is a flowchart showing an example of a process for managing a computing device.

Like reference symbols in the various drawings indicate like elements.

DETAILED DESCRIPTION

A computing device may be used for educational purposes. For example, a school may distribute tablet computers to all students and teachers where the tablet computers are loaded with educational software. Educational software may include software that is designed to help students learn and software that is designed to help teachers to teach students. For example, educational software may include software that displays lessons to students and software that allow teachers to share lessons with students.

To prevent misuse of the computing devices, the educational software may also limit capabilities of the tablet computer and provide an administration interface for managing teacher and student computing devices. For example, the computing device may prevent students from installing social media platform applications. However, in certain cases educational software may be removed or disabled from a computing device. For example, computing devices may be factory reset. A factory reset of a computing device may return a computing device to the same state as when the computing device was provided by the manufacturer of the computing device. Accordingly, if the educational software was not installed when the computing device was provided by the manufacturer, the factory reset may cause the educational software to be deleted and allow users to use the tablet computers freely for their own purposes. Accordingly, a system for managing computing devices may be designed to manage the computing devices so that the computing devices are used with the educational software, even after a factory reset.

FIG. 1 is a block diagram of an example of a system architecture for using computing devices in a learning environment. Student devices 140A-C may be used by students 150A-C in a learning environment. Briefly, the system 100 includes an instructor device 102 that may be used by an instructor 104 to teach the students 150A-C, student devices 140A-C that may be used by the students 150A-C to learn, and a server 120 that may facilitate communications between the student devices 140A-C and the instructor device 102 over a network 110.

The instructor device 102 may be a computing device used by the instructor 104. A computing device may be a tablet computer, a smartphone, a laptop computer, a desktop computer, or other appropriate computing device. The instructor device 102 may be used by the instructor 104 to notify students 150A-C to view particular educational content on the student devices 140A-C and may be used by the

instructor **104** to view information indicating if the students **150A-C** are viewing the particular educational content.

The student devices **140A-C** may be computing devices that are used by the students **150A-C**. The student devices **140A-C** may be used by the students **150A-C** to learn. For example, the student devices **140A-C** may display portions of lessons to the students **150A-C**. The student devices **140A-C** may receive notifications indicating the particular educational content that an instructor **104** has shared.

The server **120** may facilitate communications between the student devices **140A-C** and the instructor device **102** over a network **110**. For example, the server **120** may receive the indications from the instructor device **102** of particular educational contents shared by the instructor **104** to be viewed on the student devices **140A-C** by the students **150A-C**. The indications received by the server **120** may be the indications, described above, that may be provided by the instructor device **102**.

The server **120** may provide notifications to student devices **140A-C** of the particular educational contents shared by the instructor **104** to be viewed on the student devices **140A-C** by the students **150A-C**. The notifications provided by the server **120** may be the notifications, described above, that may be received by the student devices **140A-C**.

Different configurations of the system **100** may be used where functionality of the instructor device **102**, server **120**, and student devices **140A-C**, may be combined, further separated, distributed, or interchanged. For example, in another configuration of the system **100** the instructor device **102** may directly communicate with the student devices **140A-C** without the server **120** to monitor the student devices **140A-C**.

FIG. **2** is a diagram showing an example of a system **200** for managing a computing device **210**, and FIG. **3** is a flowchart **300** showing an example of a process for managing a computing device. The process of FIG. **3** may be performed by the system of FIG. **2**, and the following describes the system and process together, although the process may be performed by a different system.

Generally, the system **200** may include the computing device **210**, a network **220**, a routing server **230**, and one or more registration servers **240A-C**. The computing device **210** may be a mobile computing device, for example, a tablet, a phone, or a laptop computer. The computing device **210** may include an operating system **212**, a bootloader **214**, and a user and network registration application **216**.

The operating system **212** may be a standard operating system of the computing device **210** that manages hardware resources of the computing device **210** and provides common services for software on the computing device **210**. For example, the operating system **212** may be the Android operating system or the iOS operating system. The operating system **212** may be installed in a protected system folder of the computing device **210** so that even when the computing device **210** is factory reset, the operating system **212** may still be loaded, although settings for the operating system **212** may be reset to the initial settings provided by the manufacturer of the computing device **210**.

The bootloader **214** may be software that ensures that educational software is installed on the computing device **210**. For example, the bootloader **214** may be small lightweight software that is run during initial use of the computing device **210** and after every factory reset of the computing device **210**. The bootloader **214** may receive a boot event from the operating system **212** that indicates that the operating system **212** has finished booting (**302** and **304**).

In response to receiving the boot event, the bootloader **214** may enforce the user and network registration application **216** to be the default application that is next launched (**306**), and secure settings for the computing device **210** (**308**). For example, the bootloader **214** may disable universal serial bus (USB) debugging for the computing device **210**, disable the installation of software from unknown sources, disable the uninstallation of applications, disable the clearing of settings, and disable quick tools that may be supported by the operating system **212**. The bootloader **214** may be installed in a protected system folder of the computing device **210**, which may be the same protected system folder that the operating system **212** is installed in, so that even when the computing device **210** is factory reset, the bootloader **214** may still be retained.

Next, the bootloader **214** may only enable applications listed in a whitelist to be installed (**310**). The bootloader **214** may then determine if the computing device **210** has already been registered (**312**). The computing device **210** may be considered to be registered if the educational software is installed on the computing device **210**. Accordingly, when the computing device **210** has educational software installed, the computing device **210** may be considered to be registered, but when the computing device **210** is factory reset so that the educational software is removed, the computing device **210** may be considered to be unregistered. Alternatively or additionally, the computing device **210** may only be registered after the educational software is installed so that if the computing device **210** is registered the educational software must be installed.

The bootloader **214** may determine if the computing device **210** is already registered based on determining if educational software indicated in the whitelist is installed. If educational software is already installed, the bootloader **214** may determine that the computing device **210** is already registered. If educational software is not already installed, the bootloader **214** may determine that the computing device **210** is not registered. If the computing device **210** is registered, the bootloader **214** may launch the user and network registration application **216** (**314**).

If the computing device **210** is not registered, the bootloader **214** may check if there is memory accessible by the computing device **210** from which the educational software on the whitelist may be installed (**316**). For example, the bootloader **214** may determine if a Secure Digital (SD) memory card is accessible by the computing device **210** and determine if the memory card stores data from which the educational software on the whitelist may be installed. If the SD memory card does include data from which the educational software on the whitelist may be installed, the bootloader **214** may cause the educational software to be installed from the SD memory card.

The bootloader **214** may use a silent install process where the user of the computing device **210** may not realize that the educational software is being installed (**318**). After the educational software is successfully installed, the bootloader **214** may enforce execution of the educational software (**320**). For example, the bootloader **214** may modify a boot sequence of the computing device **210** so that after the operating system **212** is loaded, the educational software is loaded and the bootloader **214** is no longer loaded. Alternatively, if the educational software modifies a boot sequence to cause the educational software to be loaded after the operating system **212** is loaded, the bootloader **214** may disable itself so that the bootloader **214** is no longer executed when the computing device **210** is turned on. During a factory reset of the computing device **210**, the boot sequence

5

may be reverted to its original form so that the bootloader **214** is again executed to ensure that the educational software is installed.

After the bootloader **214** enforces execution of the educational software (**320**), or if the bootloader **214** determines there is no memory accessible by the computing device **210** from which the educational software on the whitelist may be installed (**316**), the bootloader **214** may determine if there is a network connection, e.g., an Internet connection (**322**). If there is no network connection, the bootloader **214** may launch the user and network registration application **216** so that the user may establish a network connection (**314**). If the bootloader **214** determines there is a network connection, the bootloader **214** may begin a device registration process.

For the device registration process, the bootloader **214** may first determine a registration location for the computing device **210** by communicating with a routing server **230** (**324**). The bootloader **214** may determine a unique identifier, e.g., a serial number, a media access control (MAC) address, etc., and an authentication key for the computing device **210**. For example, the bootloader **214** may determine the unique identifier and the authentication key from data stored in the system folder that is retained even when the computing device **210** is factory reset. The bootloader **214** may provide the unique identifier and the authentication key to a routing server **230**.

The routing server **230** may authenticate the computing device **210** based on the unique identifier and the authentication key. For example, the routing server **230** may determine that the serial number "FA3423" is to be registered with the system **200** and the authentication key "87907" is correct for the serial number. The routing server **230** may then determine which registration server **240A-C** the computing device **210** should be registered with.

Different registration servers may handle different environments. For example, a first registration server may be a demonstration server that is used for demonstrating the system **200**, a second registration server may be a development server that is used for development, a third registration server may be an active use server located in the U.S. that handles registration of computing devices used in the U.S., and a fourth registration server may be an active use server located in a different country, e.g. Europe, that handles registration of computing devices used in that country. In an example, the routing server **230** may determine that the serial number of "FA3423" is for a computing device to be used for actual use in the U.S. and route the registration to a registration server located in the U.S. that handles registration of computing devices used in the U.S.

The registration server **240** selected by the routing server **230** may then register the computing device **210** and provide educational software and policies to be enforced on the computing device **210** (**326**). The registration server **240** may determine the appropriate educational software and policies for the computing device **210** based on the unique identifier provided by the bootloader **214**. For example, the registration server **240** may determine that the serial number of the computing device **210** corresponds to a computing device to be used for a particular school system, and determine that the particular school system has determined to use a particular version of particular educational software. In the case where the educational software is already installed on the computing device **210**, e.g., from a SD card, the registration server **240** may provide updates to the software if appropriate (rather than providing the basic educational software itself) and policy settings to enforce on

6

the computing device **210**, or provide only policy settings, e.g., if there are no updates needed.

The bootloader **214** may cause any educational software or updates received from the registration server **240** to be installed and enforce the policies indicated by the registration server **240** (**328**). Once the bootloader **214** has ensured that the educational software is installed and the relevant policies enforced, the bootloader **214** may enforce execution of the educational software, e.g., modifying a boot sequence so that the educational software is launched after the operating system **212** boots and modifying the boot sequence so that the bootloader **214** is no longer executed when the computing device **210** is turned on, until the next factory reset of the computing device **210** (**330**).

The user and network registration application **216** may enable a user to register to use the system **200** and may enable the user to adjust network settings to establish a network connection. For example, if the bootloader **214** determines that no network connection is available so the computing device **210** may not be registered with the registration servers **240**, the user may adjust the network settings to establish a network connection after which the bootloader **214** may then register the computing device **210** with the registration servers **240** and allow the user to register to use the system **200**.

While the above has been described using educational software, in some implementations, the system **200** may ensure that particular non-educational software is installed instead of educational software.

What is claimed is:

1. A computer-implemented method comprising:

detecting with a bootloader that an operating system of a computing device has finished booting;

in response to detecting with the bootloader that the operating system of the computing device has finished booting, disabling installation of software on the computing device except for particular educational software;

determining that the particular educational software is not installed on the computing device;

in response to determining that educational software is not installed on the computing device; installing the particular educational software;

after installing the particular educational software, modifying a boot sequence of the computing device so that the particular educational software is executed after the operating system has finished booting; and disabling the bootloader.

2. The method of claim 1, wherein disabling installation of software on the computing device except for particular educational software comprises:

obtaining a whitelist of educational software that is permitted to be installed; and

enabling the educational software on the whitelist to be installed.

3. The method of claim 1, wherein the bootloader is installed in a protected system folder of the computing device.

4. The method of claim 1, wherein disabling installation of software on the computing device except for particular educational software comprises:

disabling universal serial bus (USB) debugging for the computing device, the installation of software from unknown sources, clearing of settings, and quick tools that may be supported by the operating system.

5. The method of claim 1, wherein installing the particular educational software comprises:

7

determining presence of memory that is accessible by the computing device that stores installation data for the particular educational software; and

installing the particular educational software from the memory that is accessible.

6. The method of claim 1, wherein disabling the bootloader comprises:

modifying the boot sequence of the computing device so that the bootloader is not loaded.

7. A system comprising:

one or more computers; and

one or more storage devices storing instructions that are operable, when executed by the one or more computers, to cause the one or more computers to perform operations comprising:

detecting with a bootloader that an operating system of a computing device has finished booting;

in response to detecting with the bootloader that the operating system of the computing device has finished booting, disabling installation of software on the computing device except for particular educational software;

determining that the particular educational software is not installed on the computing device;

in response to determining that educational software is not installed on the computing device; installing the particular educational software;

after installing the particular educational software, modifying a boot sequence of the computing device so that the particular educational software is executed after the operating system has finished booting; and

disabling the bootloader.

8

8. The system of claim 7, wherein disabling installation of software on the computing device except for particular educational software comprises:

obtaining a whitelist of educational software that is permitted to be installed; and

enabling the educational software on the whitelist to be installed.

9. The system of claim 7, wherein the bootloader is installed in a protected system folder of the computing device.

10. The system of claim 7, wherein disabling installation of software on the computing device except for particular educational software comprises:

disabling universal serial bus (USB) debugging for the computing device, the installation of software from unknown sources, clearing of settings, and quick tools that may be supported by the operating system.

11. The system of claim 7, wherein installing the particular educational software comprises:

determining presence of memory that is accessible by the computing device that stores installation data for the particular educational software; and

installing the particular educational software from the memory that is accessible.

12. The system of claim 7, wherein disabling the bootloader comprises:

modifying the boot sequence of the computing device so that the bootloader is not loaded.

* * * * *